CALIFORNIA DEPARTMENT OF JUSTICE
DIVISION OF LAW ENFORCEMENT

BUREAU OF FORENSIC SERVICES
RESPIRATORY PROTECTION PROGRAM

November 3, 1999

California Department of Justice
Division of Law Enforcement
Bureau of Forensic Services
Respiratory Protection Program

Table of Contents

1. INTRODUCTION

Scope

This program sets forth accepted practices for respirator users, and provides information and guidance on proper selection, use and maintenance of respirators.

Purpose

The purpose of this program is to ensure that the Bureau of Forensic Services Respiratory Protection Program provides guidance to all employees using respiratory protection. This program applies to all job related respiratory hazards encountered both in the field and in the laboratory.

Permissible Practice

When working in an environment containing harmful dusts, fumes, sprays, mist, fogs, smokes, vapors or gases, the primary method of protection for employees will be engineering control. This is done by ventilating, covering or substituting with less toxic materials. If necessary, administrative controls, such as limiting exposure by limiting time on a job is another alternative. If neither engineering nor administrative controls are possible, then appropriate respirators will be used.

2. RESPONSIBILITIES

Employer

- The employer shall provide approved respirators and replacement supplies when such equipment is necessary to control harmful exposures.

- The employer shall provide the procedures for the employee to properly select the correct respirator based on the potential hazard.

- The employer shall be responsible for the establishment, maintenance and evaluation of the respiratory protection program.

- The employer shall educate and annually train employees on proper respirator use.

Employee

- The employee shall use the provided respiratory protection in accordance with the instruction and training received.

- The employee shall properly clean, maintain and store the respirator.

- The employee shall report any malfunction of the respirator to their supervisor and the Senior Industrial Hygienist.

Program Administration

Program Administration of the Respiratory Protection Program will be performed by a designated Senior Industrial Hygienist in the Mission Support Branch and is hereafter called the “Program Administrator”. The Program Administrator will be responsible for:

- Providing initial and annual fit testing and associated recordkeeping.

- Providing initial and annual respirator training and associated recordkeeping.

- Providing annual medical monitoring and records of physician’s certification to wear respiratory protection.

- Implementing and retaining audit records and program evaluation reports including employee complaints, problems and suggestions.

- Revising and updating the Respiratory Protection Program as needed.

Laboratory Safety Officer

The Laboratory Safety Officer is responsible for:

- Monthly SCBA inspection including recommendations to management to obtain repairs and semi-annual flow testing.

- Ensuring compressed air cylinders are kept filled and obtaining breathing air certification.

- Maintaining SCBA and cylinder inspection records and certifications.

Site Safety Officer

The Site Safety Officer designated by the Clandestine Laboratory Manual for Instruction and Procedure is responsible for:

- Evaluating the type of Clandestine Lab and the initial respiratory protection level.

- Conducting appropriate air monitoring to determine the required respiratory protection or to determine when the required respiratory protection level can be down-graded.

- Recording air monitoring values and levels of respiratory protection on HARP forms.

3. DEFINITONS

Aerosol: a system consisting of particles, solid or liquid, suspended in air.

Air hose: a tube through which air flows to the facepiece from the regulator or pump.

Approved: Respirators that have been tested and listed as satisfactory, meeting standards set by the National Institute for Occupational safety and Health.

Canister: A large sealed container holding a filter, absorbent material or both, which removes specific contaminants from the air drawn through it.

Cartridge: A small canister with the same purpose.

Confined Space: An enclosure, such as a storage tank, silo, tank car, duct, tunnel, underground vault, cave or pit which has limited access, poor natural ventilation and which may contain a hazardous atmosphere.

Contaminant: A harmful, irritating or nuisance material that is foreign to the natural atmosphere.

Dust: A solid, mechanically produced particle with size varying from submicroscopic to visible.

End-of –Service-Life Indicator (ESLI): A device or label that warns the respirator user of the approach of the end of adequate respiratory protection, i.e. that the sorbent is approaching saturation or is no longer effective.

Escape-Only Respirator: A respirator intended to be used only for emergency exit.

Facepiece: The part of the respirator that covers the wear's eye, nose, and mouth (full facepiece). It is designed to make a gas-tight or particle-tight fit with the face and including the headbands, exhalation valve and connectors for an air purifying device (two cartridges or single canister) or air supplying source (self-contained breathing apparatus).

Filter: A device used in cartridges or canisters to remove solid or liquid aerosols from the air.

Fume: A solid particle that condenses from the air during welding or burning of metal.

Gas: A state of matter defined as a fluid with a vapor pressure exceeding 40 psia at 100^{o}F.

Immediately Dangerous to Life and Health (IDLH): An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Inhalation Valve: A device that allows respirable air to enter a respirator and prevents exhaled air from leaving the respirator through the valve.

Maximum Use Limit: The maximum concentration of a contaminant for which an air-purifying filter, cartridge or canister is approved for use.

N100: Particulate filter (99.97% filter efficiency level) is effective against particulate aerosols free of oil.

Negative Pressure Respirator: A respirator in which the air pressure inside the mask is positive during exhalation and negative during inhalation in relation to the outside air pressure.

NIOSH: National Institute for Occupational Safety and Health.

OSHA: Occupational Safety and Health Administration.

P100: Particulate filter (99.97% filter efficiency level) is effective against particulate and oily aerosols for multiple shifts.

Powered air-purifying Respirator (PAPR): An air purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Permissible Exposure Limit (PEL): The legally established time-weighted (TWA) concentrations or ceiling concentration of a contaminant that shall not be exceeded.

Positive Pressure Respirator: A respirator in which the air pressure inside the mask is always positive in relation to the outside air pressure during both inhalation and exhalation.

Protection Factor: The ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator at the breathing zone of the wearer. The protection factor is a measure of the degree of protection provided by a respirator to the wearer. These values are assigned by NIOSH.

R100: Particulate filer (99.97% filter efficiency level) is effective against particulate and oily aerosols for one work shift.

Respirator: A device designed to protect the wearer from the inhalation of harmful atmospheres.

Sanitized: To destroy organisms that cause disease or infection.

Smoke: The products of combustion, pyrolysis or chemical reaction of substances in the form of visible and invisible solid and liquid particles and gaseous products in air.

Spray: A liquid, mechanically produced particle with sizes varying from submicroscopic to visible.

Vapor: The gaseous state of a substance that is solid or liquid at ordinary temperatures and pressure.

4. CLASSIFICATION, DESCRIPTION AND LIMITATIONS OF RESPIRATORS

Air Purifying Respirators

Air Purifying Respirators (APRs) are a mask that uses either a canister or dual cartridges to remove contaminants from the atmosphere. These respirators do not protect against IDLH, oxygen deficiency or other atmospheres where contaminants are in unknown concentrations. The contaminants removed are limited by the type, efficiency and capacity of the cartridge or canister used. The SCOTT O-Vista and AV-2000 models are the primary APRs used by BFS personnel. The MSA Ultra-twin APR is the alternative brand used for personnel who cannot be fitted to wear SCOTT respirators.

SCOTT #631-OAAM (canister) and the SCOTT #642-MPC-P100 (cartridge) filters out dust, organic vapors, ammonia and amines, chlorine and hydrochloric acid and provides escape for hydrogen sulfide. The GME-H is the equivalent MSA cartridge. These canister/cartridges do not have ESLI's. Specific changeout schedules are listed in Appendix B.

Atmosphere-Supplying Respirators

Self-contained Breathing Apparatus (SCBA) are respirators that provide uncontaminated air to the wearer. The primary limitations are weight (approximately 20 pounds), bulkiness, finite air source and training needed to maintain and use. Only SCBA's providing at least 30 minutes of breathing air, operated in the positive pressure mode will be used to enter unknown atmospheres and atmospheres containing known hazardous contaminants that requires the use of an SCBA.

SCOTT is the primary brand of SCBA used and maintained by BFS. MSA is the alternative brand used for personnel who cannot be fitted to wear SCOTT respirators.

Emergency escape respirators are used in hazardous atmospheres for immediate escape only. If rescue of an employee is necessary, SCBA shall be used.

5. SELECTION OF RESPIRATORS

Approved Respirators

Only NIOSH approved respirators shall be selected. Surgical masks or unapproved dust filters shall not be substituted for approved respirators.

General Considerations

The selection of a respirator for any given situation shall require consideration of the following factors:

- The nature of the hazard
- The characteristics of the hazardous operation or process.
- The location of the hazardous area with respect to a safe area having respirable air.
- The period of time for which respiratory protection may be provided.
- The activity of the workers in the hazardous area.
- The physical characteristics, functional capabilities and limitations of various types of respirators.
- The respirator protection factor and respirator fit.

Selection Criteria at Clandestine Laboratories

Assessment

- Labs inside buildings or other spaces that do not have good ventilation and ANY lab where Hydroiodic acid/Red Phosphorous/Ephedrine (HI/RP/Ephedrine) “cooking” has been in process when the lab was entered: SCBA shall be used until the atmospheric content can be determined to be safe.
- Non-cooking Labs outside with good ventilation, or boxed labs: A full-face respirator with the standard SCOTT or MSA cartridges will be used as a precaution until it can be determined that none of the containers are open and leaking. Following the evaluation, the cartridges will be disposed of based on the change-out schedules in Appendix B.
- Air monitoring instruments (Lower Explosive Limit = 0%, Oxygen >19.5% or less than 23.5%, Phosphine <0.3 ppm) will be used to determine whether

respiratory protection continues to be necessary. Colorimetric tubes may also be used for other contaminants, such as hydrogen chloride (<5 ppm).

Disassembly

- Removal of closed chemical containers that are not leaking or do not have leakage on the outside will not require the use of respiratory protection.

- Removal of containers that cannot be closed or have leakage on the outside will required the use of SCBA if the material is liquid. If air monitoring can be conducted to determine that there is no respiratory hazard, then a full-face respirator may be used as a precaution. If the material is solid, then a full-face respirator with a standard cartridge may be used. Any person removing any container used for the cooking of a HI/RP/Ephedrine mixture will wear a phosphine monitor.

Sampling

- Household product containers: when sampling containers of household product materials or containers containing 5 gallons or less with small openings (i.e. screw top caps) out-of-doors in a well ventilated area a full face respirator with standard cartridge should be used. The cartridge will be changed after use at each site. Containers must be allowed to depressurize before sampling by slightly opening the lid. If no muriatic acid or ammonia containers are known to be present, then a full-face respirator with a standard cartridge is voluntarily (but advised).

- Sampling containers used in HI/RP/Ephedrine cooking, greater than 5 gallons in size, with large openings (i.e. open buckets) or working with small containers or items in a poorly ventilated area required the use of SCBA.

Processing for Fingerprints

- Processing closed containers in a well-ventilated area does not require the use of respiratory protection. Use of a NIOSH approved dust mask or full-face respirator with a P-100 filter is recommended to avoid inhalation of fingerprint powder.

- Processing open containers used in HI/RP/Ephedrine cooking or process solvents and wastes will require the use of SCBA unless air monitoring can verify that the container is safe for processing without SCBA.

Examination of Blood stain evidence at crime scenes

- Application of Leuco-Crystal Violet (LCV) indoors or application in poorly ventilated required the use of SCBA.

- Applications of LCV outdoors require the use of a full-face respirator with a standard cartridge. The purpose of respiratory protection is to avoid inhalation of LCV; hydrogen peroxide levels would be below the PEL (see experimental data). The cartridge must be changed after each scene or when it is difficult to breathe through.

Laboratory Spill Cleanup or Emergencies

- Small Spill Cleanup (1 gallon or less) by the Laboratory Spill Response Team will require either the use of a full-face respirator with at least a P100 filter for dry materials. For liquid materials, all lab hoods will be turned on before cleanup is started. After testing the atmosphere with appropriate instrumentation (combustible gas indicator or colorimetric tubes) to verify that the contaminant levels are below the IDLH and less than 50 times the PEL, a full-face respirator with a standard cartridge will be used. Cartridges will be discarded after use. If the contaminant levels cannot be determined, then SCBA will be used.

- Escape-only Respirators will be used solely for the purposes of escape from a dangerous environment. A SCBA will be used if rescue is required.

Justification for choosing respirators and change-out schedules is found in Appendix A and B respectively.

6. USE OF RESPIRATORS

Training

The Employee's Supervisor and the respirator wearer shall be given adequate training by a qualified person(s) to ensure proper use of respirators. Written records shall be maintained by the Program Administrator.

This training shall include the following elements:

- The basic respiratory protection practices;
- The nature and extent of respiratory hazards to which persons under the Supervisor may be exposed.
- The principles and criteria of selecting respirators.
- The training of respirator wearers.
- The issuance of respirators.
- The inspection of respirators.
- The use of respirators, including monitoring of use.
- The maintenance and storage of respirators.
- The regulations concerning respirator use.

Training of Respirator Wearers: To ensure the proper and safe use of a respirator, each respirator wearer shall receive annual training. After the training, each user must demonstrate knowledge of the following elements:

- The reasons for respiratory protection.
- The nature, extent and effects of respiratory hazards to which a person may be exposed.
- An explanation of why engineering controls are not being applied or are not adequate and of what effort is being made to preclude or eliminate the need for respirators.
- An explanation of why a particular type of respirator has been selected for a specific respirator hazard.

- An explanation of the operation, and the capabilities and limitations of the respirator selected.

- Instruction in selecting, donning, checking the fit and wearing the respirator.

- An opportunity for each respirator wearer to handle the respirator, learn how to don and wear it properly, check its seals, wear it in a safe atmosphere and wear it in a test atmosphere.

- An explanation of how maintenance and storage of the respirator is carried out.

- Instruction in how to recognize and cope with emergency situations.

- Instructions needed for special respirator use.

- Regulations concerning respirator use.

Retraining

Each respirator user shall be retrained annually on the training elements. Training competencies have to be demonstrated and documented.

Respirator Fit Tests

A *Quantitative Fit Test* using a negative pressure respirator shall be performed initially and annually thereafter to determine the ability of each individual respirator wearer to obtain a satisfactory fit with an APR. A satisfactory fit is defined as a fit factor averaging 500 or better for a full-face APR. Procedures required by 8 CCR 5144, Appendix A for the Portacount and the Controlled Negative Pressure protocol will be followed.

Respirator fit test will not be required for positive pressure SCBA. However, the individual must wear the same size and brand of APR mask to which they have been quantitatively fit tested.

A person shall be allowed to use only the specified make and model APR and SCBA for which the person has obtained a satisfactory quantitative fit. Under no circumstances shall a person be allowed to use any respirator if the results of the quantitative fit test indicate that the person is unable to obtain a satisfactory fit.

A Quantitative Fit Test shall be carried out for each wearer of a negative pressure respirator prior to initial respirator use and at least annually. A current fit test is required for use of respiratory protection in the field or the laboratory.

Respirator Fit Test Records

Initial and Annual Fit Test records will be kept by the Program Manager. The record will include:

- Employee's identification and work location.
- APR employee was fitted with.
- Whether spectacle inserts will be used.
- Whether contacts will be worn.
- Date and location of fit test.
- Type of fit test method, scores of individual tests and average fit factor.
- Identification and signature of person performing the fit test.

Respirator Inspection prior to Use

Each person issued a respirator for routine, non-routine, emergency or rescue shall inspect the respirator prior to its use to ensure that it is in good operational condition. Proper function will be evaluated using the manufacturer's inspection procedures.

Air purifying respirator inspection shall include facepiece, face shield, straps, buckles, valves, cartridges/canisters and sealing gaskets.

SCBA inspection shall include facepiece, face shield, straps, buckles, valves, breathing tubes, fittings, compressed air cylinder, air hoses, regulator and low pressure warning device.

Leaving a Hazardous Area

A respirator wearer shall be permitted to leave the hazardous area for any respirator-related cause. Reasons which require a respirator wearer to leave a hazardous area include, but are not limited to the following:

- Failure of the respirator to provide adequate protection;
- Malfunction of the respirator;
- Detection of leakage of an air contaminant into the respirator;
- Increase in resistance of the respirator to breathing

- Severe discomfort in wearing the respirator;
- Illness of the respirator wearer.

7. MAINTENANCE OF RESPIRATORS

SCBA Maintenance and Inspection

All SCBAs will be inspected monthly by the Laboratory Safety Officer or designee and noted on the inspection form found in Appendix C.

SCBA regulators must be flow tested every two years by a certified testing company. The Program Administrator will keep records of flow tests and repairs.

SCBA Cylinders:

- Must be kept at least 90% full.

- Must be filled with Grade D breathing air
  - 19.5-23.5% oxygen
  - <1000 ppm CO_2
  - <10 ppm CO
  - < 5 mg/m^3 oil mist
  - < moisture

Grade D breathing air certification must be provided when filling tanks. A copy of the certification must be obtained for documentation.

Composite cylinders shall be hydrostatically tested every three years; steel tanks must be hydrostatically tested every five years. Composite SCBA cylinders will only be used 15 years from the date of manufacture.

Any SCBA cylinder that has come in direct contact with strong acids or bases in use will be immediately decontaminated and removed from service. The cylinder shall be inspected by a manufacturer's representative to determine the integrity of the composite coating and future use. Documentation of the inspection and recommendation will be kept with the SCBA records.

Cleaning and sanitizing

Each respirator should be cleaned and sanitized after each use. Use warm water (110^oF maximum) and mild soap to clean the respirator. Rinse with clean, warm water and allow to air dry. Sanitizing is accomplished by immersing the mask for at least two minutes in one of the following solutions:

- 50 ppm bleach solution (1 ml household bleach in 1 liter of water)

- 50 ppm iodine solution (1 ml tincture of iodine to 1 liter or water) or

- a commercially prepared disinfectant recommended by the manufacturer.

Then rinse all components in fresh warm water (110^{o}F maximum) and allow to air dry.

Repair and Replacement

Replacement of parts or repairs shall only be done by persons trained in proper respirator assembly and correction of possible malfunctions or defects.

Replacement parts shall be only those designed for the specific respirator being repaired.

All records of SCBA repair will be provided to and maintained by the Program Administrator.

Storage

Respirators shall be stored in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. SCBAs, APRs and cartridges will not be operated or stored in environments below 0^{o}F or above 120^{o}F. Respirators shall be stored to prevent distortion of the elastomeric parts.

8. SPECIAL ISSUES

Corrective Vision

Employees who wear corrective lenses may either:

- Use a spectacle insert kit for the respirator. The employer will provide the kit and the prescription lenses to the employee on an annual basis.

- Use contact lenses.

No modification of the face piece is allowed.

Immediately Dangerous to Life or Health atmospheres

When an atmosphere has been characterized as IDLH due to oxygen deficiency or toxicity, then a SCBA must be used. Atmospheres containing flammable vapors may not be entered until ventilation has reduced the flammability levels to less than 10% of the LEL as measured on a combustible gas meter. Hazardous atmospheres that cannot be characterized shall be considered IDLH.

When entry into IDLH atmospheres is required, at least one standby person shall have positive pressure SCBA and appropriate retrieval equipment for removing the employee(s) who have entered the IDLH atmosphere in case of emergency. Communications (visual, voice or other suitable means) shall be maintained between the standby person and the respirator wearers. The employee(s) outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue.

Confined Spaces

All confined spaces shall be considered IDLH unless proven otherwise. Before a person is allowed to enter a confined space, all requirements of 8 CCR 5157 must be carried out, including preparation of a permit, continuous air monitoring, stationing of attendants, provision of retrieval equipment and communications equipment.

9. MEDICAL EVALUATION

No employee shall be assigned work requiring the use of a respirator, including standby-mode, or may volunteer to wear a respirator where it is not required unless it has been determined by an occupational health physician that the person is physically able to perform the work while using a respirator.

The physician's determination that an employee is certified to wear/use a respirator shall be based on medical tests and findings, including:

- Medical history.
- Pulmonary function tests
- Treadmill (when required by the physician)
- Chest X-ray (when required by the physician)

The physician's determination shall be made before the time of assignment to respirator use and updated annually. The physician' determination shall be documented on the "Physician's Certification of Employee Respirator Use" letter or similar document, singed by the examining physician and provided to the Program Administrator for each employee.

In the event that the Physician finds that an employee has a medical condition that would prevent the use of a negative pressure APR, the Physician will be required to evaluate whether a PAPR will mitigate the medical condition. If the physician determines that the PAPR is a satisfactory substitute, the employer shall provide a PAPR to the employee is if appropriate cartridges are available.

When the employee ceases to work in clandestine lab investigations, using LCV or participating as a member of a laboratory spill cleanup team, a final evaluation will be conducted and future annual evaluations will cease.

10. PROGRAM EVALUATION

The Program Administrator will annually assess implementation of the Respiratory Protection Program. Assessment will include:

- Respirator fit
- Appropriate selection based on hazard
- Proper use
- Proper maintenance

Periodic assessment of actual exposure by quantitative personal air monitoring will be conducted to verify respirator selection criteria.

APPENDIX A

Decision Logic for Respirator Selection

Justification for respirator selection is provided for the following situations:

Clan Lab Assessment

- Labs inside buildings or other spaces that do not have good ventilation and ANY lab where HI/RP/Ephedrine "cooking" has been in process when the lab was entered: SCBA shall be used until the atmospheric content can be determined to be safe.

Due to the danger of exposure to phosphine gas as well as the lack of ability to measure all toxic substances in real-time situations, SCBA will provide safe breathing air to employees involved in assessing clan labs where the likelihood of exposure to chemicals is high. Full face APRs cannot be justified unless all potential air contaminants can be measured with colorimetric tubes and the levels found to be below the IDLH and 50 times the PEL.

- Non-cooking labs outside with good ventilation, or boxed labs: A full-face respirator with the standard SCOTT or MSA cartridges will be used as a precaution until it can be determined that none of the containers are open and leaking. Following the evaluation, the cartridges will be disposed of based on the change-out schedules in Appendix B.

With good ventilation or closed containers, the employee exposure should be low. Even with good ventilation, special precautions should be taken around open containers, especially ones with large surface area. The use of colorimetric tubes should be used in these circumstances to determine that the levels of contaminant exposure are below the IDLH and within 50 times the PEL.

- Air monitoring instruments (CGI = 0%, Oxygen >19.5% or less than 23.5%, Phosphine <0.2 ppm) will be used to determine whether respiratory protection continues to be necessary. Colorimetric tubes may also be used for other contaminants, such as hydrogen chloride (<5 ppm).

Due to physical strain, it is desirable to wear the lowest level of respiratory protection necessary. This should be determined by visual inspection (e.g. closed containers, empty containers, and no leakage) and by use of monitoring equipment. Decisions to not wear respiratory protection should be based on exposure to levels that are below the PEL.

Clan Lab Disassembly

- Removal of closed chemical containers that are not leaking or do not have leakage on the outside will not require the use of respiratory protection.

No exposure would be expected if the container is closed, not leaking and not contaminated on the outside. This presumes an atmosphere that is free of contaminants and with adequate oxygen. If this were to occur in a confined space situation with high contaminant levels, respiratory protection would still have to be worn during disassembly even if the containers were closed.

- Removal of containers that cannot be closed or have leakage on the outside will required the use of SCBA if the material is liquid. If air monitoring can be conducted to determine that there is no respiratory hazard, then a full-face respirator may be used as a precaution. If the material is solid, then a full-face respirator with a standard cartridge may be used. Any person removing any container used for the cooking HI/RP/Ephedrine mixture will wear a phosphine monitor.

Due to the unknown volatile emission concentration of open or leaking liquid containers, SCBA is necessary. If air monitoring can be done with a phosphine monitor or colorimetric tubes to determine that the emissions are within PELs, then a full-face respirator may be used as a precaution. If the material is solid or powder, the P100 section of the standard cartridge is adequate to provide protection to employees.

The phosphine monitor is necessary to alert personnel to the presence of phosphine and to move the container to a location that will prevent others from being exposed.

Sampling

- Household product containers: when sampling containers of household product materials or containers containing 5 gallons or less with small openings (i.e. screw top caps) out-of-doors in a well ventilated area a full face respirator with standard cartridge should be used. The cartridge will be changed after use at each site. Containers must be allowed to depressurize before sampling by slightly opening the lid. If no muriatic acid or ammonia containers are known to be present, then a full-face respirator with a standard cartridge is voluntarily (but advised).

Air sampling data provided in Appendix B indicates that the organic substance exposure levels when opening caps from small containers will not expose employees to excessive levels of contaminants when done in a open area. Hydrochloric acid and ammonia are exceptions to this rule. Therefore, a full-face APR is required when sampling. In the event that no HCl or ammonia is known to be present, then the APR is optional since the exposure levels will be below the PEL for the expected substances. However, due to the ever-present potential for unknowns, wearing the APR is advised.

- Containers used in HI/RP/Ephedrine cooking, greater than 5 gallons in size, with large openings (i.e. open buckets) or sampling in a poorly ventilated area require the use of SCBA.

Due to the inability to properly quantify the concentration of contaminants in situations phosphine may be generated or where large surface area exposures may occur, SCBA is required to provide adequate protection to employees.

Processing for Fingerprints

- Processing closed containers in a well-ventilated area does not require the use of respiratory protection. Use of a NIOSH approved dust mask or full-face respirator with a P-100 filter is recommended to avoid inhalation of fingerprint powder.

No exposure to chemicals is anticipated if the container is kept closed and good ventilation is present. Respiratory protection is recommended, not required to reduce inhalation of fingerprint powder. Exposures to fingerprint powder are not anticipated to exceed the PEL of 5 mg/m^3 (see NIOSH Health Hazard Evaluation Report 92-0147-2456, Federal Bureau of Investigation, September, 1994).

- Processing open containers used in HI/RP/Ephedrine cooking or process solvents and wastes will require the use of SCBA unless air monitoring can verify that the container is safe for processing without SCBA.

Unless adequate air monitoring can be performed, SCBA is required to ensure that exposures to volatile and gaseous air contaminants (especially phosphine) are below regulatory levels.

Examination of Blood stain evidence at crime scenes

- Application of Leuco-Crystal Violet (LCV) indoors or application in poorly ventilated required the use of SCBA.

Due to the use of hydrogen peroxide as the carrier material, indoor application or application in poorly ventilated areas may potentially expose employees to levels exceeding the PEL. The ability of the SCOTT cartridge to absorb hydrogen peroxide has not been provided by the manufacturer, therefore SCBA is required.

- Applications of LCV outdoors require the use of a full-face respirator with a standard cartridge. The purpose of respiratory protection is to avoid inhalation of LCV; hydrogen peroxide levels would be below the PEL (see experimental data). The cartridge must be changed after each scene or when it is difficult to breathe through.

Exposure to hydrogen peroxide volatilizing from a 3 % solution in a well-ventilated area would be below the PEL. See experimental data in Appendix B.

Laboratory Spill Cleanup or Emergencies

- Small Spill Cleanup (1 gallon or less) by the Laboratory Spill Response Team will require either the use of a full-face respirator with at least a P100 filter for dry

materials. For liquid materials, all lab hoods will be turned on before cleanup is started. After testing the atmosphere with appropriate instrumentation (combustible gas indicator or colorimetric tubes) to verify that the contaminant levels are below the IDLH and less than 50 times the PEL, a full-face respirator with a standard cartridge will be used. Cartridges will be discarded after use. If the contaminant levels cannot be determined, then SCBA will be used.

Particulate filters will adequately protect employees. The use of monitoring equipment is necessary to determine that the APR is appropriate. If this cannot be determined, then SCBA must be used.

- Escape-only Respirators will be used solely for the purposes of escape from a dangerous environment. A SCBA will be used if rescue is required.

Escape-only respirators are designed for the wearer to place them on and leave the area; the unit does not supply enough air to permit personnel to perform rescue. If rescue is required, then SCBA must be used.

APPENDIX B

Respirator Change-out Schedules

1. Rule of Thumb

If the chemical's boiling point is >70^{o}C and the concentration is less than 200 ppm, you can expect a service life of 8 hours at a normal work rate. Service life is inversely proportional to work rate. Reducing concentration by a factor of 10 will increase service life by a factor of five. Humidity above 85% will reduce service life by 50%.

Examples: toluene, trichloroethylene. However, even though ethyl alcohol fits the rule of thumb, experimental data indicates that the effectiveness of activated carbon in absorbing ethyl alcohol is not very efficient and maximum wear times are considerably less than that predicted by the "Rule of Thumb".

2. Experimental Evidence

A. Organic solvents

The following is data collected by BFS when opening chemical containers with screw top lids 2.25 inches in diameter. Fifty milliliters of each substance was used. After 10 seconds of swirling, the cap was opened and samples were collected at 1 foot directly above the container. Real-time analysis was obtained with a Foxboro MIRAN 1BX. The 70 and 100^{o}F columns indicate actual chemical concentrations recorded at those temperatures. All values are in "PPM". Except for chloroform, respiratory protection would not be required when sampling these substances. Time in minutes refers to cartridge change-out time if a respirator is elected to be worn.

Chemical	PEL PPM	70^{o}F PPM	Time-min	100^{o}F PPM	Time-min
Acetone	750	40	43	184	32
Chloroform	2	32	445	114	218
Ethyl Alcohol	1000	62	47	44(114*)	35
Ethyl Ether	100	26	285	34(58*)	117
Methyl Alcohol	200	150	0	146(279*)	0
Toluene	50	9	>8 hr	48	>8hr
Trichloroethylene	25	37	>8hr	20	>8hr

* = level measured when lid opened first time after heating without swirling.

B. Hydrogen Peroxide

Using Draeger colorimetric tubes, exposure to hydrogen peroxide was measured in the following situations after a 1 $ft.^2$ section of concrete was saturated by a handsprayer:

1. Outdoors, in full sun, temperature 90^oF, measured 2 inches off concrete = 0.3 ppm
2. Outdoors, in full sun, temperature 90^oF, measured 12 inches off concrete = 0.5 ppm
3. Outdoors, in full shade, temperature 90^oF, measured 12 inches off concrete = 0.1 ppm
4. Enclosed garage, temperature 85^oF, measured 12 inches off concrete = 0.5 ppm
5. Inside a bucket, inside a room, temperature 85^oF, measured 12 inches off surface = 6 ppm.

The Permissible Exposure Limit for hydrogen peroxide is 1 ppm.

C. Hydrogen Chloride

Using Draeger colorimetric tubes, exposure to hydrogen chloride was measured at a height of 1 foot above the lip:

Conditions	Concentration measured @70^oF	Concentration measured @95^oF
Laboratory grade HCl: 37-39% 1 inch opening	10 ppm	Not tested
Consumer grade drain cleaner HCl 10%, 90% inert Screw-top container, 2.25 inch dia.	0 ppm	0 ppm

This data shows that if any laboratory grade HCl is suspected which must be sampled, then a respirator must be used. Based on MSA data for an exposure to 10 ppm, the change-out schedule would be 1440 minutes. Therefore, BFS will require change-out after use at each site.

3. Manufacturer's Experimental Data

Change-out schedules for the SCOTT 642-MPC respirator cartridges are listed on the following pages.

ESTIMATED CARTRIDGE BREAKTHROUGH TIME FOR THE SCOTT 642-MPC MULTI-PURPOSE TWIN CARTRIDGE

MEDIUM WORK RATE, 22 ^{o}C AND LESS THAN 65 % RH

CHEMICAL	ESTIMATED CARTRIDGE SERVICE LIFE IN HOURS AT					
	CAS NO.	10 ppm	50 ppm	100 ppm	500 ppm	1000 ppm
Acetic anhydride	108-24-7	98.4	33.5	21.0	7.2	4.5
Acetone	67-64-1	27.9	9.5	6.0	2.0	1.3
Acrylonitrile	107-13-1	36.9	12.6	7.9	2.7	1.7
Allyl acetate	591-87-7	60.3	20.5	12.9	4.4	2.8
Allyl alcohol	107-18-6	52.4	17.8	11.2	3.8	2.4
Allyl chloride	107-05-1	24.6	8.4	5.3	1.8	1.1
Benzene	71-43-2	57.9	19.7	12.4	4.2	2.6
Bromobenzene	108-86-1	106.9	36.4	22.9	7.8	4.9
Butanol	71-36-3	91.3	31.0	19.5	6.6	4.2
Butanol, 2-	78-92-2	76.2	25.9	16.3	5.5	3.5
Butanone, 2-	78-93-3	61.8	21.0	13.2	4.5	2.8
Butyl acetate	123-86-4	61.1	20.8	13.1	4.4	2.8
Butyl acetate, sec-	105-46-4	65.9	22.4	14.1	4.8	3.0
Butylamine	109-73-9	82.8	28.2	17.7	6.0	3.8
Carbon tetrachloride	56-32-5	61.1	20.8	13.1	4.4	2.8
Chlorobenzene	108-90-7	84.9	28.9	18.2	6.2	3.9
Chlorobutane, 1-	109-69-3	57.1	19.4	12.2	4.2	2.6
Chlorocyclopentane	930-28-9	61.9	21.1	13.2	4.5	2.8
Chloroform	67-66-3	26.2	8.9	5.6	1.9	1.2
Chloroheptane, 1-	629-06-1	65.1	22.1	13.9	4.7	3.0
Chlorohexane, 1-	544-10-5	61.1	20.8	13.1	4.4	2.8
Chloromethyl heptane, 3-	123-04-6	50.0	17.0	10.7	3.6	2.3
Chloropentane, 1-	543-59-9	59.5	20.2	12.7	4.3	2.7
Chloropropane, 1-	540-54-5	19.8	6.7	4.2	1.4	0.9
Chloropropane, 2-	75-29-6	20.6	7.0	4.4	1.5	0.9
Chlorotoluene, o-	95-49-8	80.9	27.5	17.3	5.9	3.7
Chloro-2-methylbutane, 2-	594-36-5	46.8	15.9	10.0	3.4	2.1
Chloro-2-methylpropane, 2-	507-20-0	29.4	10.0	6.3	2.1	1.3
Cumene	98-82-8	64.3	21.9	13.7	4.7	2.9
Cycloheptatriene, 1,3,5-	544-25-2	91.1	31.0	19.5	6.6	4.2
Cyclohexane	110-82-7	52.0	17.7	11.1	3.8	2.4
Cyclohexanone	108-94-1	94.9	32.3	20.3	6.9	4.3
Cyclohexene	110-83-8	64.8	22.0	13.8	4.7	3.0
Cyclohexylamine	108-91-8	84.3	28.7	18.0	6.1	3.9
Cyclooctane	292-64-8	73.0	24.8	15.6	5.3	3.3
Cyclopentanone	120-92-3	106.2	36.1	22.7	7.7	4.9
Cymene, p-	99-87-6	60.3	20.5	12.9	4.4	2.8
Decane	124-18-5	53.5	18.2	11.4	3.9	2.4
Dibromoethane, 1,2-	106-93-4	106.2	36.1	22.7	7.7	4.9
Dibromomethane	74-95-3	61.8	21.0	13.2	4.5	2.8
Dibutylamine	111-92-2	57.2	19.5	12.2	4.2	2.6
Dichlorobenzene, 1,2-	95-50-1	86.5	29.4	18.5	6.3	4.0
Dichlorobutane, 1,4-	110-56-5	85.7	29.2	18.3	6.2	3.9
Dichloroethane, 1,1-	75-35-4	18.3	6.2	3.9	1.3	0.8

Dichloroethane, 1,2-	107-06-2	42.9	14.6	9.2	3.1	2.0
Dichloroethylene, 1,2-*cis*-	156-59-2	23.8	8.1	5.1	1.7	1.1
Dichloroethylene, 1,2-*trans*-	156-60-5	26.2	8.9	5.6	1.9	1.2
Dichloromethane	75-09-2	7.9	2.7	1.7	0.6	0.4
Dichloropropane, 1,2-	78-87-5	51.6	17.5	11.0	3.8	2.4
Dichloropropene, 1,3-	542-75-6	68.2	23.2	14.6	5.0	3.1
Diethylamine	109-89-7	66.3	22.5	14.2	4.8	3.0
Diisobutyl ketone	108-83-8	53.5	18.2	11.4	3.9	2.4
Diisopropylamine	108-18-9	58.0	19.7	12.4	4.2	2.7
Dimethylamine	124-40-3	12.8	4.4	2.7	0.9	0.6
Dimethylbutane, 2,3-	79-29-8	54.2	18.4	11.6	3.9	2.5
Dipropylamine	142-84-7	70.0	23.8	15.0	5.1	3.2
Epichlorohydrin	106-89-8	68.2	23.2	14.6	5.0	3.1
Ethanol	64-17-5	22.2	7.6	4.8	1.6	1.0
Ethoxyethanol, 2-	110-80-5	61.1	20.8	13.1	4.4	2.8
Ethoxyethlyacetate, 2-	111-15-9	63.5	21.6	13.6	4.6	2.9
Ethyl acetate	141-78-6	53.2	18.1	11.4	3.9	2.4
Ethyl benzene	100-41-4	66.7	22.7	14.3	4.8	3.0
Ethyl chloride	75-00-3	4.8	1.6	1.0	0.3	0.2
Ethylamine	75-04-7	30.9	10.5	6.6	2.2	1.4
Ethylidene-5-norbornene, 2-	16219-75-3	65.5	22.3	14.0	4.8	3.0
Ethyl-1-butanol, 2-	97-95-0	61.1	20.8	13.1	4.4	2.8
Heptane	142-82-5	58.7	20.0	12.6	4.3	2.7
Heptanone, 2-	110-43-0	76.1	25.9	16.3	5.5	3.5
Heptanone, 3-	106-35-4	68.5	23.3	14.7	5.0	3.1
Hexane	110-54-3	39.2	13.3	8.4	2.8	1.8
Hexyl acetate	142-92-7	53.2	18.1	11.4	3.9	2.4
Isopentyl acetate	123-92-2	56.3	19.2	12.0	4.1	2.6
Isopropanol	67-63-0	42.9	14.6	9.2	3.1	2.0
Isopropenyl acetate	108-22-5	64.3	21.9	13.7	4.7	2.9
Isopropyl acetate	108-21-4	51.6	17.5	11.0	3.8	2.4
Isopropylamine	75-31-0	49.7	16.9	10.6	3.6	2.3
Mesityl oxide	141-79-7	91.9	31.3	19.6	6.7	4.2
Mesitylene	108-67-8	68.2	23.2	14.6	5.0	3.1
Methanol	67-56-1	0.16	0.05	0.034	0.012	0.007
Methoxyethanol, 2-	109-86-4	92.1	31.3	19.7	6.7	4.2
Methoxyethylacetate, 2-	110-49-6	73.8	25.1	15.8	5.4	3.4
Methyl acetate	79-20-9	26.2	8.9	5.6	1.9	1.2
Methyl chloride	74-87-3	0.04	0.01	0.008	0.003	0.002
Methyl chloroform	71-55-6	31.7	10.8	6.8	2.3	1.5
Methyl iodide	74-88-4	9.0	3.1	1.9	0.7	0.4
Methylamine	74-89-5	9.0	3.1	1.9	0.7	0.4
Methylcyclohexane	108-87-2	52.0	17.7	11.1	3.8	2.4
Methylcyclohexanone, 4-	589-92-4	83.6	28.4	17.9	6.1	3.8
Methylcyclopentane	96-37-7	46.7	15.9	10.0	3.4	2.1
Methyl-3-cyclohexanone	591-24-2	76.1	25.9	16.3	5.5	3.5
Methyl-3-butanol, 1-	123-41-3	77.0	26.2	16.5	5.6	3.5
Methyl-4-pentanone, 2-	108-10-1	72.3	24.6	15.5	5.3	3.3
Methyl-4 pentanol, 2-	108-11-2	59.5	20.2	12.7	4.3	2.7
Methyl-5-heptanone, 3-	541-85-5	64.8	22.0	13.8	4.7	3.0
Nitropropane, 1-	108-03-2	107.7	36.6	23.0	7.8	4.9
Nonane	111-84-2	57.2	19.5	12.2	4.2	2.6
Pentachloroethane	76-01-7	73.8	25.1	15.8	5.4	3.4
Pentane	109-66-0	45.9	15.6	9.8	3.3	2.1
Pentanedione, 2,4-	123-54-6	97.9	33.3	20.9	7.1	4.5
Pentanol	71-41-0	80.9	27.5	17.3	5.9	3.7
Pentanol, 2-	6032-29-7	69.0	23.5	14.8	5.0	3.2
Pentanone, 2-	107-87-9	78.3	26.6	16.7	5.7	3.6
Pentanone, 3-	96-22-0	70.8	24.1	15.1	5.1	3.2
Pentyl acetate	628-63-7	57.9	19.7	12.4	4.2	2.6

Perchloroethylene	127-18-4	84.9	28.9	18.2	6.2	3.9
Propanol	71-23-8	55.6	18.9	11.9	4.0	2.5
Propyl acetate	109-60-4	62.7	21.3	13.4	4.6	2.9
Propylamine	107-10-8	67.8	23.1	14.5	4.9	3.1
Pyridine	110-86-1	89.6	30.5	19.2	6.5	4.1
Tetrachloroethane, 1,1,2,2-	79-34-5	82.5	28.1	17.6	6.0	3.8
Toluene	108-88-3	74.6	25.4	15.9	5.4	3.4
Trichloroethane, 1,1,2-	79-00-5	57.1	19.4	12.2	4.2	2.6
Trichloroethylene	79-01-6	43.6	14.8	9.3	3.2	2.0
Trichloropropane, 1,2,3-	96-18-4	88.1	30.0	18.8	6.4	4.0
Triethylamine	121-44-8	61.0	20.8	13.0	4.4	2.8
Trimethlypentane, 2,2,4-	540-84-1	51.2	17.4	10.9	3.7	2.3
Trimethylhexane, 2,2,5-	35-94-9	51.2	17.4	10.9	3.7	2.3
Vinyl acetate	108-05-4	43.6	14.8	9.3	3.2	2.0
Vinyl chloride	75-01-4	3.2	1.1	0.7	0.2	0.1
Xylene, m-	108-38-3	78.6	26.7	16.8	5.7	3.6

Cartridge lives at 1000 ppm represent experimental 1% breakthrough data points obtained in the 1970's adjusted for a medium work rate and the increased carbon volume and capacity of current cartridge technology. This data is applicable for ambient conditions at 22 °C, relative humidities from 0 to 65% and a medium work rate (25 LPM). The other breakthrough times were calculated from Equation 2 taken from Nelson, G. O. and A. N. Correia, "Respirator Cartridge Efficiency Studies: VIII Summary and Conclusions" Am. Ind. Hyg. Assoc. J. 37: 514 (1976). These tests and calculations assume no safety factor.

For temperatures at 32 ^{o}C, multiply breakthrough times by 0.8.
For temperatures at 12 ^{o}C, multiply breakthrough times by 1.2.

For relative humidities between 65 and 80 %, multiply breakthrough times by 0.9.
For relative humidities between 80 and 95 %, multiply breakthrough times by 0.8.

These tests were performed under laboratory conditions and not under actual use conditions. Miller-Nelson Research Inc makes no warranties Miller-Nelson Research Inc makes no warranties concerning protection by these air purifying respirator devices.
These cartridge lives are estimates and the user should determine the suitability of the devices under actual field conditions

Compiled by Miller-Nelson Research Inc, 8 Harris Ct., Suite C-6, Monterey, CA 93940

Appendix C

SCBA MONTHLY CHECKOUT

SCBA HARNESS #_____

MONTH/YEAR							
CYLINDER INSPECTION Hydro test date: must be <3 yrs composite, <5 yrs steel. Exterior of cylinder, Threads, valve knob							
CYLINDER PRESSURE (Full-ok; Partial <90% **–DO NOT USE UNTIL REFILLED**)							
HARNESS ASSEMBLY							
FACE PIECE ASSEMBLY							
REGULATOR ASSEMBLY (high pressure o-ring, hoses)							
FUNCTION CHECK-REGULATOR & ALARM							
DISCREPANCIES NOTED:							
DATE DISCREPANCIES RESOLVED							
INITIAL:							